Yangtze River observational system to improve East Asian rainy season forecasting

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Researchers have completed the first ever multi-level hydrological tracking of the Yangtze River from the ground, air and space in order to investigate the properties of cloud formation during the mei-yu—an

intense rainy season that forms part of East Asia's summer monsoon. The effort should permit greater understanding of the mei-yu precipitation process and thus enable much more accurate forecasts of this key meteorological phenomenon in the region.

The mei-yu, also known as the 'Plum Rain,' is a period of severe, concentrated rainfall that lasts for up to two months during the late spring and early summer, covering mainland China, Taiwan, Japan and Korea.

This intense weather phenomenon arises from interactions between systems of convection (transfer of heat within a fluid) at multiple, mid-range or mesoscale levels, ranging from 2-20 km up to 20-200 km. These are considered mesoscale because they develop at a larger level than microscale, or under 1 km-sized phenomena, such as small, fleeting, cloud 'puffs,' but still smaller than synoptic scale phenomena over 1000 km such as cyclones.

Conventional observations cannot deliver the detailed spatial and temporal variations that exist within such mid-ranking multi-scale convective systems. Nor can they describe their cloud structures or microphysical processes and properties. As a result, researchers with the Hubei Key Laboratory for Heavy Rain Monitoring and Warning Research, at the China Meteorological Administration's Institute of Heavy Rain, organized an ambitious monitoring effort that itself works at multiple levels along the middle and lower reaches of the Yangtze River.

The Integrative Monsoon Frontal Rainfall Experiment (IMFRE-II) took place during ten heavy rainfall events of the 2020 mei-yu and employed ground-based, airborne and satellite observations.

"Last year's mei-yu was a particularly extreme one that broke records,"

said meteorologist Chunguang Cui, lead author of the study, published on Jan 5 in the journal *Advances in Atmospheric Physics* . It lasted 44 days, some 19 days longer than average—the eighth longest mei-yu since 1951, at a greater than normal intensity, and over a larger area. "This was a gift in terms of the data we were able to gather."

The campaign involved the use of seven aircraft flights measuring various attributes of ice particles, cloud droplets and raindrops at various altitudes, as well as seven ground-based observation systems and global precipitation measurement (GPM) satellites.

IMFRE-II followed on from IMFRE-I, which was conducted in 2018 over the middle reaches of the Yangtze. In 2022, the researchers hope to carry out a third such effort.

In combination, the three field campaigns will allow the researchers to investigate the microphysical properties of clouds and precipitation in a mei-yu, and significantly improve the computer models describing how the mei-yu system forms and later disperses. This will in turn give a big boost to the accuracy of mei-yu forecasts, of enormous benefit to the agricultural sector and flood protection planning.

More information: Chunguang Cui et al, Phase Two of the Integrative Monsoon Frontal Rainfall Experiment (IMFRE-II) over the Middle and Lower Reaches of the Yangtze River in 2020, *Advances in Atmospheric Sciences* (2021). DOI: 10.1007/s00376-020-0262-9

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